

REMARKS

By the present amendment and response, claim 11 has been amended to overcome the Examiner's objections and new claims 20-29 have been added. Thus, claims 11, 14-16, 18, 19, and 20-29 are pending in the present application. Reconsideration and allowance of outstanding claims 11, 14-16, 18, 19, and 20-29 in view of the following remarks are requested.

The Examiner has rejected claims 11, 14-16, and 18 under 35 USC 102(e) as being anticipated by U.S. patent number 6,392,294 B1 to Tomoji Yamaguchi ("Yamaguchi"). The Examiner has further rejected claim 19 under 35 USC 103(a) as being unpatentable over Yamaguchi. For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 11, is patentably distinguishable over Yamaguchi. However, Applicant believes that the present invention was conceived and reduced to practice prior to the effective filing date of Yamaguchi. As such, Applicant reserves the right to provide declarations and/or documents under 37 CFR 1.131 to "swear behind" the effective filing date of Yamaguchi.

Subject to Applicant's reserved right to establish priority of the present invention under 37 CFR 1.131, Applicant submits that the present invention, as defined by amended independent claim 11 includes, among other things, a printed circuit board comprising first and second layers of metal on bottom and top surfaces, respectively, of the printed circuit board, and a blind hole traversing the second layer of metal of the printed circuit board, where the blind hole is filled with mold compound, which also surrounds and

covers a die. As disclosed in the present application, when the blind hole is filled with mold compound during a molding process, the portion of mold compound in the blind hole acts as a plug and locks the mold compound into the printed circuit board. As a result, the present invention advantageously provides increased adhesion between the mold compound and the second layer of metal on the top surface of the printed circuit board, which allows the mold compound to provide better protection against separation of a die from a die-attach area on the printed circuit board.

Furthermore, in contrast to a through hole, the blind hole does not extend completely through the printed circuit board and, as such, does not penetrate the first layer of metal on the bottom surface of the printed circuit board. Thus, since the present invention, as defined by amended independent claim 11, utilizes a blind hole filled with mold compound to lock the mold compound into the printed circuit board instead of a through hole, the first layer of metal on the bottom surface of the printed circuit board can be advantageously utilized as desired without having to accommodate a hole in the first layer of metal.

In contrast to the present invention as defined by amended independent claim 11, Yamaguchi does not teach, disclose, or suggest a blind hole traversing a layer of metal of a printed circuit board, where the blind hole is filled with mold compound, which also surrounds and covers a die. Yamaguchi specifically discloses through holes 13, which are formed in substrate 1a and filled with molten resin material. See, for example, Yamaguchi, column 4, lines 61-64. Through holes 13 may be formed by laser drilling at

particular positions corresponding to bores 20a and 20b, which have smaller diameters than through holes 13. See, for example, column 5, lines 43-45 and Figure 2 of Yamaguchi. Through holes 13 are formed by a laser beam emitter from the below substrate 1a such that through holes 13 are formed in line with bores 20a and 20b. See, for example, column 5, lines 45-49 and Figure 2 of Yamaguchi. Thus, Yamaguchi teaches away from utilizing blind holes in place of through holes 13, since through holes 13 must be formed from below substrate 1a to align with smaller diameter bores 20a and 20b. For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 11, is not suggested, disclosed, or taught by Yamaguchi. As such, the present invention, as defined by amended independent claim 11, is patentably distinguishable over Yamaguchi. Thus, respective dependent claims 14-16, 18, and 19 are also patentably distinguishable over Yamaguchi.

The present invention, as defined by new independent claim 20, includes, among other things, a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is filled with mold compound selected from the group consisting of multifunctional epoxy, novolac, and biphenyl resin, and where the mold compound is locked into the first and second layers of metal of the printed circuit board. As disclosed in the present application, by utilizing a mold compound selected from the group consisting of multifunctional epoxy, novolac, and biphenyl resin, the present invention achieves a strong chemical bond between the mold compound in the through hole and the walls of the through hole, which comprise resin. Furthermore, as disclosed

in the present application, the relatively rough surfaces of the mold compound and resin on the walls of the through hole form a strong mechanical bond. The chemical and mechanical bond between resin on the walls of the through hole and the mold compound effectively “stake down” the mold compound to the second layer of metal on the top surface of the printed circuit board. Furthermore, the mold compound in the through hole is also locked into the first and second layers of metal of the printed circuit board to additionally secure the mold compound to the top surface of the printed circuit board.

In contrast to the present invention as defined by new independent claim 20, Yamaguchi does not teach, disclose, or suggest a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is filled with mold compound selected from the group consisting of multifunctional epoxy, novolac, and biphenyl resin, and where the mold compound is locked into the first and second layers of metal of the printed circuit board. Yamaguchi specifically discloses through holes 13, which are formed in substrate 1a. See, for example, Figure 2 of Yamaguchi. Bores 20a and 20b are formed in metal conductor 2 on upper surface 10 of substrate 1a over through holes 13. See, for example, column 5, lines 20-31 and Figure 2 of Yamaguchi. In Yamaguchi, resin material fills through holes 13 and bores 20a and 20b situated directly above through holes 13. However, in Yamaguchi, there is no layer of metal on the bottom surface of substrate 1a that the resin material is locked into. Furthermore, in Yamaguchi, the resin material comprises a thermosetting resin. Yamaguchi does not teach, disclose, or suggest a mold compound selected from the group consisting of

multifunctional epoxy, novolac, and biphenyl resin. In fact, Yamaguchi does not even mention any chemical or mechanical bond that may be formed between the resin material and the walls of through holes 13. For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by new independent claim 20, is not suggested, disclosed, or taught by Yamaguchi. As such, the present invention, as defined by new independent claim 20, is patentably distinguishable over Yamaguchi. Thus, respective dependent claims 21-24 are also patentably distinguishable over Yamaguchi.

The present invention, as defined by new independent claim 25 includes a plastic laminate-based molded printed circuit board package comprising, among other things, a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is filled with mold compound, and where the mold compound is locked into the first and second layers of metal of the printed circuit board. As disclosed in the present application, the plastic laminate-based molder printed circuit board package includes a standard laminate printed circuit board comprising first and second layers of metal, respectively, on bottom and top surfaces of the printed circuit board. The through hole can be readily formed, for example, by simply drilling a hole through the printed circuit board including the first and second layers of metal. By filling the through hole with mold compound, the present invention achieves a cost-effective plastic laminate-based molder printed circuit board package that utilizes mold compound in the through hole to act as a plug to lock the mold compound into the printed circuit board. Furthermore, the mold compound is also locked into the first and second layers of metal

of the printed circuit board to additionally secure the mold compound to the printed circuit board.

In contrast to the present invention as defined by new independent claim 25, Yamaguchi does not teach, disclose, or suggest a plastic laminate-based molder printed circuit board package including a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is filled with mold compound, and where the mold compound is locked into the first and second layers of metal of the printed circuit board. As discussed above, Yamaguchi specifically discloses through holes 13, which are formed in substrate 1a and bores 20a and 20b, which are formed in metal conductor 2 on upper surface 10 of substrate 1a over through holes 13. In Yamaguchi, bores 20a and 20b, which are a smaller diameter than through holes 13, must first be formed in metal conductor 2. Through holes 13 are then formed in substrate 1a by drilling a hole from the bottom of substrate 1a such that through holes 13 are in line with bores 20a and 20b. Furthermore, through holes 13 are not formed in a printed circuit board comprising first and second layers of metal, respectively, on bottom and top surfaces of the printed circuit board. Through holes 13 are formed only in substrate 1a. As such, when through holes 13 are filled with resin material, the resin material in through holes 13 is not locked into first and second layers of metal of a printed circuit board. In fact, Yamaguchi does not teach, disclose, or suggest a printed circuit board comprising first and second layers of metal, respectively, on bottom and top surfaces of the printed circuit board. As such, the present invention, as defined by new independent

claim 25, is patentably distinguishable over Yamaguchi. Thus, respective dependent claims 26-29 are also patentably distinguishable over Yamaguchi.

Based on the foregoing reasons, the present invention, as defined by amended independent claim 11 and new independent claims 20 and 25, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 11, 14-16, 18, 19, and 20-29 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early Notice of Allowance of claims 11, 14-16, 18, 19, and 20-29 pending in the present application is respectively requested.

Respectfully Submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Claim 11 has been amended as follows:

11. (Thrice Amended) A structure comprising:

a printed circuit board including a die attached to a top surface of said printed circuit board;

said printed circuit board comprising a first layer of metal on a bottom surface of said printed circuit board;

said printed circuit board further comprising a second layer of metal on said top surface of said printed circuit board, wherein said second layer of metal is situated below said die;

a [through] blind hole traversing said [first and] second layer[s] of metal of said printed circuit board, said [through] blind hole being adjacent to said die, said [through] blind hole being filled with a mold compound, said [through] blind hole being unplated, said mold compound surrounding and covering said die, wherein said mold compound is locked into said [first and] second layer[s] of metal of said printed circuit board.